

EXERCISES

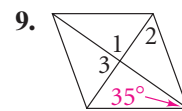
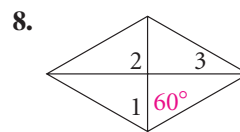
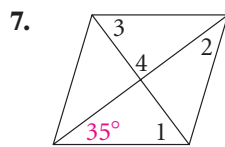
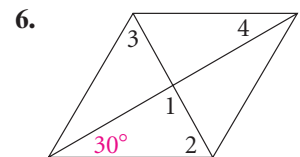
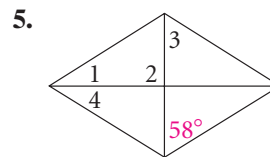
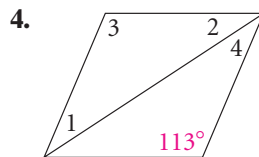
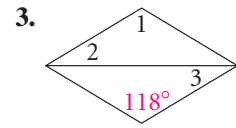
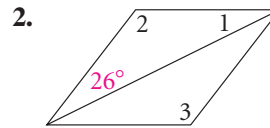
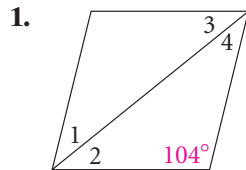
For more practice, see *Extra Practice*.

Practice and Problem Solving

A Practice by Example

Example 1
(page 313)

Find the measures of the numbered angles in each rhombus.



Example 2 x^2 **Algebra** $LMNP$ is a rectangle. Find the value of x and the length of each diagonal.
(page 314)

10. $LN = x$ and $MP = 2x - 4$

11. $LN = 5x - 8$ and $MP = 2x + 1$

12. $LN = 3x + 1$ and $MP = 8x - 4$

13. $LN = 9x - 14$ and $MP = 7x + 4$

14. $LN = 7x - 2$ and $MP = 4x + 3$

15. $LN = 3x + 5$ and $MP = 9x - 10$

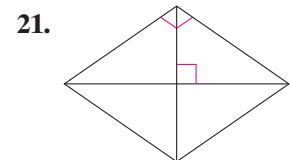
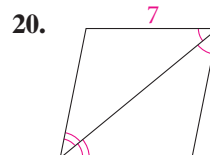
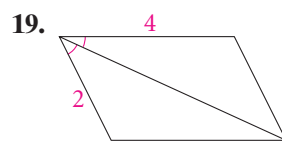
Example 3
(page 314)

Determine whether the quadrilateral can be a parallelogram. (The diagrams in Exercises 19–21 may not be to scale.) If not, write *impossible*. Explain.

16. The diagonals are congruent, but the quadrilateral has no right angles.

17. Each diagonal is 3 cm long and two opposite sides are 2 cm long.

18. Two opposite angles are right angles, but the quadrilateral is not a rectangle.



Example 4
(page 315)

B Apply Your Skills

22. Hardware You can use a simple device called a turnbuckle to “square up” structures that are parallelograms. For the gate pictured at the right, you tighten or loosen the turnbuckle on the diagonal cable so that the cable stays congruent to the other diagonal. Explain why a frame that normally is rectangular will, when it sags, keep the shape of a parallelogram.

23. Carpentry A carpenter is building a bookcase. How can she use a tape measure to check that the bookshelf is rectangular? Justify your answer and name any theorems used.

24. Reasoning Suppose the diagonals of a parallelogram are both perpendicular and congruent. What type of special quadrilateral is it? Explain your reasoning.



Using Symbols Create your own distinctive symbols for parallelogram, rhombus, rectangle, and square. Then copy the properties in Exercises 25–34. After each property, use your symbols to list the quadrilaterals having that property.

25. All sides are \cong .

26. Opposite sides are \cong .

27. Opposite sides are \parallel .

28. Opposite \angle s are \cong .

29. All \angle s are right \angle s.

30. Consecutive \angle s are supplementary.

31. Diagonals bisect each other.

32. Diagonals are \cong .

33. Diagonals are \perp .

34. Each diagonal bisects opposite \angle s.

Which, if any, of the properties in Exercises 25–34 can the following type of quadrilateral have? Draw diagrams to illustrate.

35. a trapezoid

36. a kite

37. a quadrilateral that is not a special quadrilateral



38. Writing Summarize the properties of squares that follow from a square being (a) a parallelogram, (b) a rhombus, and (c) a rectangle.

Constructions Explain how to construct each figure, given its diagonals.

39. parallelogram

40. rectangle

41. rhombus

42. square

43. kite

44. trapezoid



Reading Math

In Exercises 39–44, the “given diagonals” are two segments you draw. The constructed figures must have diagonals that match.



Need Help?

To review what makes a good definition, see Lesson 2-2.

Reasoning Decide whether each of these is a good definition. Justify your answer.

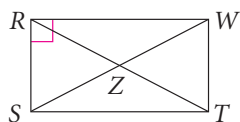
45. A rectangle is a quadrilateral with four right angles.

46. A rhombus is a quadrilateral with four congruent sides.

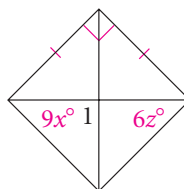
47. A square is a quadrilateral with four right angles and four congruent sides.

x² Algebra Find the value(s) of the variable(s) for each parallelogram.

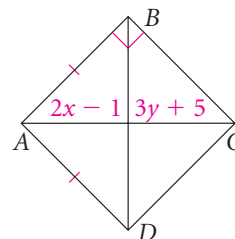
48. $RZ = 2x + 5$,
 $SW = 5x - 20$



49. $m\angle 1 = 3y - 6$



50. $BD = 4x - y + 1$



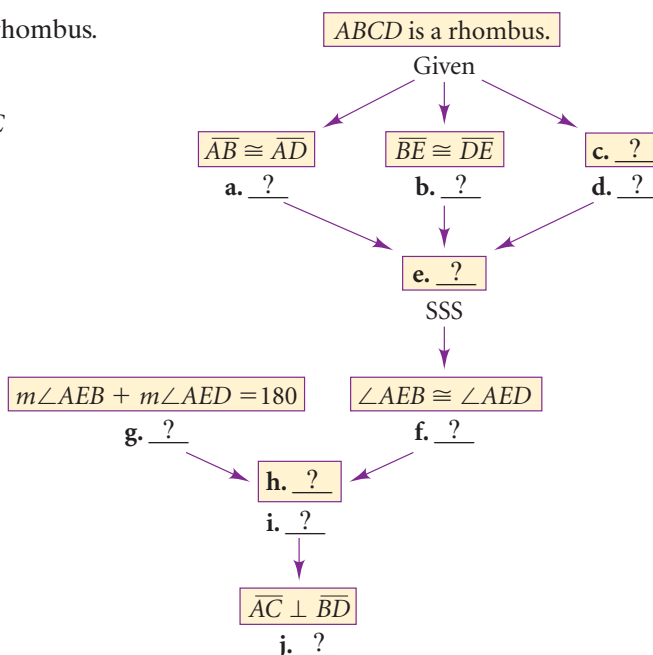
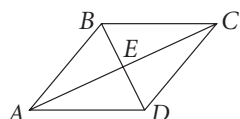
Open-Ended Given two segments with lengths a and b ($a \neq b$), what special quadrilaterals can you sketch that meet these conditions? Show each sketch.

51. Both diagonals have length a . 52. The two diagonals have lengths a and b .
53. One diagonal has length a , one side of the quadrilateral has length b .

Proof 54. **Developing Proof** Complete the flow proof of Theorem 6-10.

Given: $ABCD$ is a rhombus.

Prove: $\overline{AC} \perp \overline{BD}$



55. **Critical Thinking** The hypothesis of Theorem 6-12 mentions one diagonal of a parallelogram. Why doesn't it include both diagonals?

Proof 56. In Theorem 6-12, replace "two angles" with "one angle." Write a paragraph that proves this new statement true or show a counterexample to prove it false.

x² Algebra $ABCD$ is a rectangle. Find the length of each diagonal.

57. $AC = 2(x - 3)$ and $BD = x + 5$

58. $AC = 2(5a + 1)$ and $BD = 2(a + 1)$

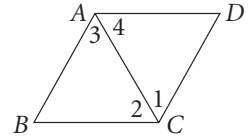
59. $AC = \frac{3y}{5}$ and $BD = 3y - 4$

60. $AC = \frac{3c}{9}$ and $BD = 4 - c$

61. **Developing Proof** Fill in Steps 4–7 that are missing from this proof of Theorem 6-12. (Using more than four steps is acceptable.)

Given: $ABCD$ is a parallelogram;
 \overline{AC} bisects $\angle BAD$ and $\angle BCD$.

Prove: $ABCD$ is a rhombus.



Statements	Reasons
1. $ABCD$ is a parallelogram. \overline{AC} bisects $\angle BAD$ and $\angle BCD$.	1. Given
2. $\angle 1 \cong \angle 2$, $\angle 3 \cong \angle 4$	2. Definition of bisect
3. $\overline{AC} \cong \overline{AC}$ \vdots	3. Reflexive Property of Congruence \vdots
8. $ABCD$ is a rhombus.	8. Definition of rhombus



Challenge Proof

62. Write a paragraph proof (Thm. 6-13). 63. Write a flow proof (Thm. 6-14).

Given: $\square ABCD$; $\overline{AC} \perp \overline{BD}$ at E .

Prove: $ABCD$ is a rhombus.

Given: $\square ABCD$; $\overline{AC} \cong \overline{BD}$

Prove: $ABCD$ is a rectangle.



Standardized Test Prep

Multiple Choice



Take It to the NET

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Web Code: afa-0604

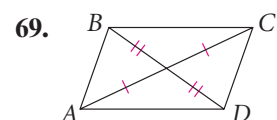
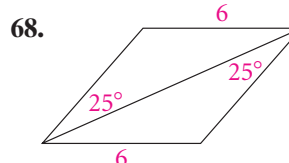
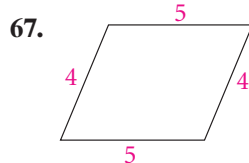
Short Response

64. The diagonals of a quadrilateral are perpendicular bisectors of each other. What name best describes the quadrilateral?
 A. rectangle B. parallelogram C. quadrilateral D. rhombus
65. The diagonals of a quadrilateral bisect both pairs of opposite angles. What name best describes the quadrilateral?
 F. parallelogram G. quadrilateral H. rectangle I. rhombus
66. **Given:** $QRST$ is a rhombus, \overline{QS} intersects \overline{RT} at P , $QR = 9$ cm, and $QP = 4.5$ cm. Find $m\angle RST$. Explain your work.

Mixed Review

Lesson 6-3

Can you conclude that the quadrilateral is a parallelogram? Explain.

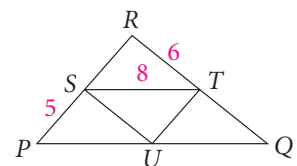


Lesson 5-1

In $\triangle PQR$, points S , T , and U are midpoints. Complete each statement.

70. $TQ = ?$ 71. $PQ = ?$ 72. $TU = ?$

73. $\overline{SU} \parallel ?$ 74. $\overline{TU} \parallel ?$ 75. $\overline{PQ} \parallel ?$



Lesson 3-3 x^2 76. **Algebra** Find the value of c .

